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Coastal Marine Biodiversity of Viet Nam: State and Current Problems

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ABSTRACT: The present project was intended to study marine biological diversity in coastal zones of Viet Nam, its modern status, threats, and recent and modifications due to global change and human impact. A synthesis of data and original research were conducted on coral reef modifications, biota of the intertidal zone, meiobenthic communities, species richness of rare groups of animals and economically important molluscs and the results of this synthesis and research are presented. There are numerous threats to marine biodiversity in the coastal zones of Viet Nam: habitat degradation, fragmentation and loss; global climate change including sea level rise, storm events, rainfall pattern change, warming of the coastal ocean; effects of fishing and other forms of overexploitation; pollution and marine litter; species introduction/invasion; physical alterations of coasts; and tourism. The data of Vietnamese and Russian researchers on biodiversity and coastal zone management was consolidated and used to interpret ecosystem changes and develop recommendations for local/national decision makers. The project's outcomes are not only relevant to coastal zones of Viet Nam, but may also contribute to current understanding of the entire ecosystem of the South China Sea.

KEYWORDS: *Viet Nam, marine biodiversity, coral reefs, coastal zone, threats*

Introduction

The main objectives of the project were to collect information about species diversity and to compile species lists of some taxonomic groups of biota in Viet Nam coastal zones as a basis for monitoring expected changes; to develop approaches for monitoring biodiversity

changes in the South China Sea; to document species diversity in island ecosystems along the Viet Nam coast as a baseline study for conserving coastal and marine biodiversity; to conduct inter-comparisons of coastal biodiversity status in the South China Sea and adjacent regions; to hold joint workshops on biodiversity of the coastal zones of Viet Nam involving scientists from Viet

Nam, Russia, and Korea; to the results of the project; and, also through this project, prepare and publish the monograph "Biodiversity and Bioresources of the Viet Nam Coastal Waters" as a final outcome of the project; and, through the project activity, to enhance regional cooperation in global change research on biodiversity, to increase the number of joint publications, and to involve as many young scientists as possible in regional biodiversity research.

Methodology

The project collected and analysed relevant data on biodiversity through literature study and through original biodiversity/ecological research on some groups of animals (nemertean, sipunculids, gastropod and bivalve molluscs), meiobenthic organisms, and macrobenthos of intertidal communities. Some data collected during past decades and archived in Russian institutions, were summarised for the first time.

Specific methods used in the field studies are described in the Final Activity Report of the project (available on <http://www.apn-gcr.org/resources/items/show/1591>).

Results and Discussion

The richness and productivity of the coastal coral reefs of the South China Sea are seriously threatened by the high rate of population growth, pollution, excessive harvesting and habitat modification, resulting in a

rapid loss of habitat and impairment of the regenerative capacities of living systems. Viet Nam has been considered as rich in marine biodiversity both in terms of coral diversity and typical tropical marine ecosystems. Marine resources are significant in terms of livelihoods of coastal communities and development of the country. Located in the tropical monsoon area of Southeast Asia (SEA), marine waters of central Viet Nam are characterised by high biodiversity of coral fauna and high abundance of coral reefs. However, coral biodiversity and the state of coral reefs in Viet Nam are threatened by human activities and natural impacts induced by global climate change that tend to reduce species diversity and put more species on the verge of extinction.

Based on various literature data, the survey of coral reefs in Viet Nam during the last 15 years shows that the area of coral reefs has been reduced by 15-20%, mainly in coastal waters of the central part of Viet Nam from Da Nang to Binh Thuan province. Coal dust has caused the death to large areas of corals in the Ha Long and Bai Tu Long bays (Quang Ninh Province). Along with the decline in coral reef coverage, the number of species has also been reduced. For example, the coverage of coral reefs in Bai Tien area (Nha Trang) was 30% in 1984 with 60 species, has been reduced to 1% by 1998 with 30 species. Other living organisms were also reduced in number significantly.

At present, many other countries surrounding the South China Sea have degraded reefs, for example reefs around Hainan Island have been degraded by

HIGHLIGHTS

- » Literature review shows that during the last 15 years, the area of coral reefs in Viet Nam have been reduced by 15-20%, mainly in coastal waters of the central part from Da Nang to Binh Thuan Province. Coal dust has caused death to large areas of corals in the Ha Long and Bai Tu Long bays (Quang Ninh Province). The number of species of corals (species richness) also declined — in some areas from 60 species to 30.
- » Studies on the biota of intertidal zone of some Vietnamese islands show that diversity of macrobenthos on hard substrates is richest in qualitative and quantitative compositions whereas the diversity of benthic organisms in the silty-stony intertidal zone and sandy beaches is poor. Macrophytic algae in the upper horizon and the major part of the middle horizon of surf-open sandy beaches are not found. These data may serve as a basis for future long-term monitoring of biodiversity changes.
- » The distribution and density of meiobenthos were studied in bottom sediments of Ha Long and Nha Trang estuaries, both in northern Viet Nam, for the first time. These organisms are good indicators of environmental pollution.
- » The biodiversity of rare and little-known groups of invertebrates in coastal zones of Viet Nam was studied for the first time. Twenty species in eleven genera and five families of Sipunculida were recognised in South Viet Nam.
- » Threats to marine biodiversity in Viet Nam include habitat degradation, fragmentation and loss; global climate change including sea level rise, storm events, rainfall pattern change, warming of the coastal ocean; effects of fishing and other forms of overexploitation; pollution and marine litter; species introduction/invasions; physical alterations of coasts; and tourism.



Figure 1-2 (L-R).
The settlements
of branched stony
corals *Acropora* and
Pocillopora in Viet
Nam (courtesy of
Tatyana Dautova);
A sipunculid species
Siphonosoma
australe from Viet
Nam (courtesy of
Anastasya Mayorova).

95%. Sustainable use and protection of the SEA coastal reefs are now a focus of the international agendas (see reviews in: Dautova & Lutaenko, 2010, in Project Publications).

The biota of the intertidal zone of the Vietnamese islands from Namzu Islands (9°40' N, 104°22' E) in the Gulf of Thailand to Daochao Island (20°50' N, 107°20' E) in the Gulf of Tonkin were studied based on previously taken collections. Belt-forming communities of macrobenthos were investigated in five bionomical types of the intertidal zone. These data may serve as a basis for future long-term monitoring of biodiversity changes.

In the intertidal zone of studied areas, 101 plant and 268 animal species were found. Biota of the intertidal zone is typical for tropical region of the Pacific Ocean. Tropical and tropical-subtropical species prevail (for the south Viet Nam coast – 54 species, or 34%, for the Central Viet Nam coast – 61, or 33%, and for the North Viet Nam coast – 50, or 39%); faunal elements with wide distribution (from notal to boreal sea waters) are represented as well, but in low proportions.

Macrobenthos on hard substrates (the rocky and rocky-blocky-bouldery intertidal zone) is the richest in qualitative and quantitative compositions, whereas species composition on crumbly substrates (the silty-stony intertidal zone and sandy beaches) is the poorest. Macrophytic algae are not found in the upper horizon and in the major part of the middle horizon of surf-open sandy beaches. The intertidal zone of dead coral reef has no analogues in temperate waters (see: Lutaenko, 2011 in Project Publications).

For the first time, the distribution of taxonomical composition and density of meiobenthos depending on some factors of environment were studied in bottom sediments of the northern estuary of Ha Long Bay – a total of 66 species belonging to 17 families and 52 genera were identified. The estuary of the Ha Long

Bay is exposed constantly to anthropogenic impact of seaport activities (e.g., bottom dredging works), and to freshwater drainage from the mainland which results in significant seasonal changes of salinity.

In general, differences in composition and distribution of meiobenthic communities in Ha Long Bay appeared to be connected with changes in granulometric composition of bottom sediments. The silted sediments are characterised by the low species diversity and higher density of the animals than the slightly silted sands. The meiobenthos density at Nha Trang Bay reefs also shows an uneven distribution and depends on the sediment type. The correlation analysis revealed the dependence of the median diameter of sediment particles on the density of meiobenthos.

However, taxonomic diversity of meiobenthos in Nha Trang Bay (26 groups) was greater than in other areas. Nematodes dominated in bottom sediments both in Nha Trang Bay itself and on its reefs. In total, representatives of 4 orders, 28 families and 97 genera were found in Nha Trang Bay. Nematodes made up to more than 90% of the total population density of meiobenthos at stations with high number of silt particles in sediments. Probably, oxygen deficiency is a limiting factor for the penetration of animals into the depth of sediments in the central part of Nha Trang Bay.

The biodiversity of rare and little-known groups of invertebrates (nemertean, sipunculids and opisthobranch molluscs) of Viet Nam was studied for the first time. Twenty species in eleven genera and five families of Sipunculida are recognised from the total 371 individuals collected in southern Viet Nam. An analysis of the literature on Sipunculida shows that 5 of these species are new for Nha Trang Bay. 157 species of opisthobranch molluscs are recorded in southern Viet Nam, about half of them for the first time. About 80 nemertean species belonging to 5

orders: Archinemertea (4 species), Tubulaniformes (2 species), Heteronemertea (32 species), Polystilifera (6 species), and Monostilifera (36 species) were collected in Viet Nam, a majority for the first time.

An extensive literature review was also undertaken with regard to molluscan biodiversity in the South China Sea. Based on data obtained from this review, it appears that the richest faunas of bivalve molluscs are found in Viet Nam (more than 800 species) and in the Philippines-Indonesian region (more than 1200 species). The diversity of bivalves appears to show an increase from north (Taiwan and Guangdong Province, 401–463 species) to south, (as latitudinal gradient of biodiversity is widely known in biogeography). The impoverished character of the bivalve faunas of the Tonkin Gulf and the Gulf of Thailand can be explained by significant river discharge which decreases salinity.

Results and Conclusions

As noted at the beginning of this paper, the many threats to marine biodiversity in Viet Nam include habitat degradation, fragmentation and loss (especially important are mangrove forest destruction, loss of coral reefs, change in landscape mosaic of wetland, estuary, sand and mud flats); global climate change including sea level rise, storm events, rainfall pattern change, warming of the coastal ocean; effects of fishing and other forms of overexploitation; pollution and marine litter; species introduction/invasion;

physical alterations of coasts; and tourism.

This project sought to fill knowledge gaps for biodiversity in the coastal zone of Viet Nam, taking into account the impact of the threats identified above. The project collected and analysed relevant data on biodiversity through literature study and through original biodiversity/ecological research on some groups of animals (nemerteans, sipunculids, gastropod and bivalve molluscs), meiobenthic organisms, and macrobenthos of intertidal communities.

The literature study was based in large part on data collected since the 1980s and archived in Russian institutions which were summarised for the first time. Current original researches were conducted. As a result of the literature study and of the researches, overviews of the present state of knowledge on corals and bivalve molluscs, two ecologically and economically important groups, were prepared; a number of papers were published (especially a monograph on “Biodiversity and Bioresources of Viet Nam Coastal Waters”); and a book is in preparation.

Two workshops were held, one in the Institute of Oceanography, Viet Nam Academy of Science and Technology (VAST) and one in the Research Institute of Aquaculture No. 3 in Nha Trang, to enhance regional and international cooperation in biodiversity research and to involve young scientists.

From this study, it appears that the tropical marine biodiversity of Viet Nam and South China Sea – even in developed countries like Singapore is



Figure 3. Participants of the biodiversity meeting.

still insufficiently studied and would benefit from additional research in the long term. However, such research faces some serious problems. Research on molluscan biodiversity in the South China Sea is hampered by a lack of taxonomic expertise in many countries in this region, by a lack of professional malacologists trained in taxonomy, and by the fact that there are few well-curated research collections/museums with voucher specimens in the region. Education and training of additional experts in these areas would be very helpful, as would the establishment of additional research collections/museums.

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